IN THE CLAIMS:

1. A time division duplex (TDD) antenna array synchronous code division multiple access (S-CDMA) communications system for communicating message data to/from a plurality of terminals, comprising:

a multichannel transceiver array comprising a plurality of antennas and a plurality of transceivers, wherein said multichannel transceiver array is adapted for receiving combinations of multichannel uplink S-CDMA signals from said terminals and transmitting multichannel downlink S-CDMA signals towards said terminals, wherein said multichannel transceiver array is adapted for receiving said combinations of multichannel uplink S-CDMA signals from said terminals and transmitting multichannel downlink S-CDMA signals towards said terminals during different time frames in a time division duplex manner;

a spatial processor coupled to said multichannel transceiver array for determining spatial signature estimates associated with said terminals from said combinations of multichannel uplink S-CDMA signals, wherein said spatial processor is also operable to calculate uplink and downlink beamforming matrices based on the spatial signature estimates;

a demodulator coupled to said spatial processor and said multichannel transceiver array for determining estimates of uplink messages from said terminals from said combinations of multichannel uplink S-CDMA signals, wherein the demodulator uses the uplink beamforming matrices in determining the estimates of the uplink messages from the terminals; and

a modulator coupled to said spatial processor and said multichannel transceiver array for generating said multichannel downlink S-CDMA signals to transmit messages destined for said terminals, wherein the modulator uses the downlink beamforming matrices for generating the multichannel downlink S-CDMA signals to transmit the messages destined for the terminals.

2. The TDD antenna array CDMA communications system as defined by claim 1, wherein each of said terminals includes a unique PN code sequence, the system further comprising:

a despreader coupled to said demodulator and said spatial processor, wherein, for each of said plurality of terminals, said despreader uses the terminal's PN code sequence to despread said combination of multichannel uplink S-CDMA signals to obtain a multichannel symbol sequence, wherein said multichannel symbol sequence comprises a plurality of symbol sequences;

wherein said spatial processor produces said spatial signature estimate in response to said multichannel symbol sequence.

3. The TDD antenna array CDMA communications system as defined by claim 2,

wherein said spatial processor identifies a symbol sequence from said multichannel symbol sequence with a maximum signal power and further operates to normalize said multichannel symbol sequence with respect to said identified symbol sequence with the maximum signal power to obtain a normalized multichannel symbol sequence; and

wherein said spatial processor operates to calculate the average of said normalized multichannel symbol sequence to produce said spatial signature estimate.

4. The TDD antenna array S-CDMA communications system as defined by claim 2,

wherein said spatial processor forms a data convariance matrix of said multichannel symbol sequence;

wherein said spatial processor calculates the principal eigenvector of said data covariance matrix as said spatial signature estimate.

5. The TDD antenna array S-CDMA communications system as defined by claim 1,

wherein said spatial processor is operable to determine individual multipath parameters including direction of arrival (DOA) estimates associated with each of said terminals;

wherein said DOA estimates are used in locating said terminals and in assisting handoff.

6. The TDD antenna array S-CDMA communications system as defined by claim 5, wherein said spatial processor determines DOA estimates based on a respective terminal's spatial signature estimate.

7. The TDD antenna array S-CDMA communications system as defined by claim 5, wherein said spatial processor determines DOA estimates based on a data covariance matrix of a multichannel symbol sequence associated with a respective terminal.

8. The TDD antenna array S-CDMA communications system as defined by claim 1,

wherein said spatial processor determines an uplink power estimate associated with each of said terminals;

wherein said uplink power estimate is used for power control;

wherein said spatial processor determines said uplink power as the principal eigenvalue of a data covariance matrix of a multichannel symbol sequence associated with a respective terminal.

9. The TDD antenna array S-CDMA communications system as defined by claim 1,

wherein said spatial processor determines an uplink power estimate associated with each of said terminals;

wherein said uplink power estimate is used for power control;

wherein said spatial processor determines said uplink power as a quadratic mean of a beamformed symbol sequence associated with a respective terminal.

10. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein said spatial processor determines timing offset estimates associated with each of said terminals, wherein said timing offset estimates are used for synchronization of said terminals.

11. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein said spatial processor further includes:

means for determining individual multipath parameters including direction of arrival (DOA) estimates associated with each of said terminals, wherein said DOA estimates are used in assisting handoff;

means for determining timing offset estimates associated with each of said terminals, wherein said timing offset estimates are used for synchronization; and

means for determining the geolocation of a respective terminal by combining said DOA estimates and distance information provided by said timing offset estimates.

12. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein each of said terminals includes a unique PN code sequence, the system further comprising:

a despreader coupled to the demodulator and the spatial processor, wherein, for each of said terminals, said despreader operates to despread said multichannel uplink S-CDMA signals to obtain an associated spatial signature estimate, wherein, for each respective terminal of said plurality of terminals, said despreader uses said respective terminal's PN code sequence to despread said combination of multichannel uplink S-CDMA signals to obtain a multichannel symbol sequence, wherein said multichannel symbol sequence comprises a plurality of symbol sequences for each of the transceivers comprised in the multichannel transceiver array;

wherein the demodulator is coupled to the despreader and receives said multichannel symbol sequence output from said despreader, wherein said demodulator includes:

an uplink beamformer for obtaining enhanced signals for a respective terminal by combining said multichannel symbol sequence using said respective terminal's uplink beamforming matrix, and

a detector for determining message data transmitted by said respective terminal from said enhanced signals;

wherein code and spatial diversities are both used to suppress interference and noise in signal reception.

13. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein said modulator includes:

a PN code generator for providing PN codes for each of said terminals;

a spreader coupled to said PN code generator for generating S-CDMA signals for each of said terminals, wherein said spreader uses a respective PN code for each of said terminals in generating said S-CDMA signals for each of said terminals;

a downlink beamformer for producing beamformed S-CDMA signals for each of said terminals, wherein said downlink beamformer uses said transmit beamforming matrices associated with each of said terminals in producing said beamformed S-CDMA signals for each of said terminals; and

a combiner for combining said beamformed S-CDMA signals to produce said multichannel downlink S-CDMA signals;

wherein code and spatial diversities are both used to suppress interference and noise in signal transmission.

14. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein, for at least a subset of said terminals, the uplink beamforming matrix for a respective terminal is identical to the spatial signature estimate for said respective terminal.

15. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein, for at least a subset of said terminals, the uplink beamforming matrix for a respective terminal is constructed based on the spatial signature estimates of each of

said terminals to maximize a signal-to-interference-and-noise ratio (SINR) for said respective terminal.

16. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein, for at least a subset of said terminals, the uplink beamforming matrix for a respective terminal is constructed based on the spatial signature estimates of each of said terminals to minimize a bit-error-rate (BER) for said respective terminal.

17. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein, for at least a subset of said terminals, the downlink beamforming matrix for a respective terminal is identical to the spatial signature estimate for said respective terminal.

18. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein, for at least a subset of said terminals, the downlink beamforming matrix for a respective terminal is constructed based on the spatial signature estimates of each of said terminals to maximize a signal-to-interference-and-noise ratio (SINR) for said respective terminal.

19. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein, for at least a subset of said terminals, the downlink beamforming matrix for a respective terminal is constructed based on the spatial signature estimates of each of said terminals to minimize a bit-error-rate (BER) for said respective terminal.

20. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein each of said transceivers in said multichannel transceiver array comprises transmitter circuits and receiver circuits;

the system further comprising:

means for calibrating said multichannel transceiver array to correct for imbalance of said multichannel transceivers;

wherein said means for calibrating said receiver circuits operates before estimation of said spatial signatures;

wherein said means for calibrating said transmitter circuits operates before.the transmission of said multichannel downlink S-CDMA signals.

21. The TDD antenna array S-CDMA communications system as defined by claim 1, wherein said spatial processor, said demodulator and said modulator are implemented by one or more digital processors.

22. A method for communicating message data to/from a plurality of terminals, comprising:

receiving combinations of multichannel uplink S-CDMA signals from said terminals and

determining spatial signature estimates associated with the terminals from said combinations of multichannel uplink S-CDMA signals;

calculating uplink and downlink beamforming matrices based on the spatial signature estimates;

demodulating uplink messages from said terminals from said combinations of multichannel uplink S-CDMA signals, wherein said determining estimates of said uplink messages uses said uplink beamforming matrices;

modulating multichannel downlink S-CDMA signals to transmit messages destined for said terminals;

transmitting said multichannel downlink S-CDMA signals towards said terminals;

wherein said receiving is adapted for receiving combinations of multichannel uplink S-CDMA signals from said terminals during a first time frame, and wherein said transmitting is adapted for transmitting multichannel downlink S-CDMA signals towards said terminals during a second time frame in a time division duplex manner.

23. The method of claim 22, wherein each of said terminals includes a unique PN code sequence, the method further comprising:

despreading, for each of said plurality of terminals, said combination of multichannel uplink S-CDMA signals with said respective terminal's PN code sequence to obtain a multichannel symbol sequence, wherein said multichannel symbol sequence comprises a plurality of symbol sequences;

wherein said determining spatial signature estimates comprises:

identifying a sequence from said multichannel symbol sequence, with the maximum signal power;

normalizing said multichannel symbol sequence with respect to said identified symbol sequence with the maximum signal power to obtain a normalized multichannel symbol sequence; and

calculating the average of said normalized multichannel symbol sequence to produce said spatial signature estimate.

24. The method of claim 22, wherein each of said terminals includes a unique PN code sequence, the method further comprising:

despreading, for each of said plurality of terminals, said combination of multichannel uplink S-CDMA signals with said respective terminal's PN code sequence to obtain a multichannel symbol sequence, wherein said multichannel symbol sequence comprises a plurality of symbol sequences;

wherein said determining spatial signature estimates comprises:

forming a data convariance matrix of said multichannel symbol sequence;

calculating the principal eigenvector of said data covariance matrix as said spatial signature estimate.

25. The method of claim 22, wherein said determining spatial signature estimates further includes:

determining individual multipath parameters including direction of arrival (DOA) estimates associated with each of said terminals;

wherein said DOA estimates are used in locating said terminals and in assisting handoff.

26. The method of claim 25, wherein said determining individual multipath parameters determines DOA estimates based on a respective terminal's spatial signature estimate.

27. The method of claim 25, wherein said determining individual multipath parameters determines DOA estimates based on a data covariance matrix of a multichannel symbol sequence associated with a respective terminal.

28. The method of claim 22, wherein said determining spatial signature estimates further includes:

determining an uplink power estimate associated with each of said terminals;

wherein said uplink power estimate is used for power control;

wherein said determining said uplink power estimate determines said transmission power as the principal eigenvalue of a data covariance matrix of a multichannel symbol sequence associated with a respective terminal.

29. The method of claim 22, wherein said determining spatial signature estimates further includes:

determining an uplink power estimate associated with each of said terminals;

wherein said uplink power estimate is used for power control;

wherein said determining said uplink power estimate determines said uplink power as a quadratic mean of a multichannel symbol sequence associated with a respective terminal.

30. The method of claim 22, wherein said determining spatial signature estimates further includes:

obtaining timing offset estimates associated with each of said terminals, wherein said timing offset estimates are used for synchronization.

31. The method of claim 22, wherein said determining spatial signature estimates further includes:

determining individual multipath parameters including direction of arrival (DOA) estimates associated with each of said terminals, wherein said DOA estimates are used in handoff;

obtaining timing offset estimates associated with each of said terminals, wherein said timing offset estimates are used for synchronization

determining the geolocation of a respective terminal by combining said DOA estimates and distance information provided by said timing offset estimates.

32. The method of claim 22, wherein each of said terminals includes a unique PN code sequence, the method further comprising:

despreading, for each of said plurality of terminals, said combination of multichannel uplink S-CDMA signals with said respective terminal's PN code sequence to obtain a multichannel symbol sequence, wherein said multichannel symbol sequence comprises a plurality of symbol sequences;

performing uplink beamforming to obtain enhanced signals for a respective terminal, wherein said performing uplink beamforming operates by combining said multichannel symbol sequence using said respective terminal's receive beamforming matrix, and

determining message data transmitted by said respective terminal from said enhanced signals;

wherein code and spatial diversities are both used to suppress interference and noise in signal reception.

33. The method of claim 22, wherein said modulating includes:

generating PN codes for each of said terminals;

spreading message signals for each of said terminals, wherein said generating uses a respective PN code for each of said terminals in generating S-CDMA signals for each of said terminals;

performing downlink beamforming to produce beamformed S-CDMA signals for each of said terminals, wherein said performing downlink beamforming uses said downlink beamforming matrices associated with each of said terminals in producing said beamformed S-CDMA signals for each of said terminals; and

combining said beamformed S-CDMA signals to produce said multichannel downlink S-CDMA signals;

wherein code and spatial diversities are both used to suppress interference and noise in signal transmission.

34. The method of claim 22, wherein, for at least a subset of said terminals, the uplink beamforming matrix for a respective terminal is identical to the spatial signature estimate for said respective terminal.

35. The method of claim 22, further comprising:

for at least a subset of said terminals, constructing the uplink beamforming matrix for a respective terminal based on the spatial signature estimates of each of said terminals to maximize the signal-to-interference-and-noise ratio (SINR) for said respective terminal.

36. The method of claim 22, further comprising:

for at least a subset of said terminals, constructing the uplink beamforming matrix for a respective terminal based on the spatial signature estimates of each of said terminals to minimize the bit-error-rate (BER) for said respective terminal.

37. The method of claim 22, wherein, for at least a subset of said terminals, the downlink beamforming matrix for a respective terminal is identical to the spatial signature estimate for said respective terminal.

38. The method of claim 22, further comprising:

for at least a subset of said terminals, constructing the downlink beamforming matrix for a respective terminal based on the spatial signature estimates of each of said terminals to maximize the signal-to-interference-and-noise ratio (SINR) for said respective terminal.

39. The method of claim 22, further comprising:

for at least a subset of said terminals, constructing the downlink beamforming matrix for a respective terminal based on the spatial signature estimates of each of said terminals to minimize the bit-error-rate (BER) for said respective terminal.

40. The method of claim 22, wherein the method operates in a Time Division Duplex (TDD) antenna array Synchronous Code Division Multiple Access (S-CDMA) communications system for communicating message data to/from a plurality of terminals, wherein the system comprises a multichannel transceiver array, wherein each of said transceivers in said multichannel transceiver array comprises transmitter circuits and receiver circuits;

the method further comprising:

calibrating said multichannel transceiver array to correct for imbalance of said multichannel transceivers;

wherein said calibrating said receiver circuits operates before said determining spatial signature estimates;

wherein said calibrating said transmitter circuits operates before said transmitting said multichannel downlink S-CDMA signals.

41. A smart antenna base station comprising:

a spatial signature estimator for estimating a plurality of spatial signatures associated with a plurality of uplink signals received from a corresponding plurality of remote terminals wirelessly coupled to the base station, the plurality of uplink signals simultaneously received on a common carrier frequency during an uplink time slot;

a downlink beamformer coupled to said spatial signature estimator and responsive to the plurality of spatial signatures for beamforming a plurality of downlink beamforms correspondingly unique to each of the plurality of remote terminals and for simultaneously transmitting a plurality of downlink signals to the plurality of remote terminals on the common carrier frequency during a downlink time slot subsequent to the uplink time slot; and

a code division multiple access modulator coupled to said downlink beamformer for code modulating each of the plurality of downlink signals on a corresponding plurality code channels whereby each of the plurality of downlink signals has a unique downlink beamform and a unique code channel on the common carrier frequency;

a parameter estimator coupled to said spatial signature estimator for further processing at least one of the plurality of spatial signatures for determining a corresponding direction of arrival vector associated with a remote terminal of the plurality of remote terminals, wherein said downlink beamformer is not dependent upon the direction of arrival vector for beamforming a downlink beamform associated with the remote terminal.

42. The smart antenna base station according to claim 41 wherein said spatial signature estimator determines a timing offset unique to each of the plurality of remote terminals for communication thereto, thereby enabling synchronization of each of the plurality received uplink signals.

43. The smart antenna base station according to claim 41 wherein at least one of the plurality of downlink beamforms is substantially identical to a corresponding at least one of the plurality of spatial signatures.

44. The smart antenna base station according to claim 41 wherein at least one of the plurality of downlink beamforms is optimized for maximum signal-to-interference-and noise performance by accounting for noise characteristics as well as other spatial parameters.

45. The smart antenna base station according to claim 41 wherein at least one of the plurality of downlink beamforms is optimized for maximum bit-error-rate performance by accounting for noise characteristics as well as other spatial parameters.

46. The smart antenna base station according to claim 41 further comprising:

a demodulator for demodulating each of the plurality of uplink signals received by an array of antenna elements to produce a multiplicity of demodulated uplink signals having the plurality of uplink signals received by each element of the array of antenna elements, wherein

said spatial signature estimator is coupled to said demodulator and estimates the plurality of spatial signatures in response to the multiplicity of demodulated uplink signals, the smart antenna base station further comprising

a modulator coupled to the array of antenna elements and said downlink beamformer for producing a multiplicity of modulated downlink signals having components associated with each element of the array of antenna elements by uniquely modulating each of the plurality of downlink signals for each element of the array of antenna elements to beamform the plurality of downlink beamforms.

47. The smart antenna base station according to claim 46 wherein each of the spatial signatures is either a vector or a matrix, further wherein the matrix is used in applications where a propagation channel is frequency selective with long delay multipath.

48. The smart antenna base station according to claim 46 wherein the number of the plurality of downlink beamforms exceeds the number of elements of the array of antenna elements thereby making the base station an adaptive antenna system rather than a sectored antenna system.

49. The smart antenna base station according to claim 46 wherein said demodulator is further responsive to said spatial signature estimator for constructively combining at least one uplink signal of the plurality of uplink signals received upon each

element of the array of antenna elements to produce a constructively combined demodulated uplink signal in response to an uplink beamforming vector substantially identical to a spatial signature of the plurality of spatial signatures associated with the at least one uplink signal.

50. The smart antenna base station according to claim 46 wherein said demodulator is further responsive to said spatial signature estimator for constructively combining at least one uplink signal of the plurality of uplink signals received upon each element of the array of antenna elements to produce a constructively combined demodulated uplink signal in response to an uplink beamforming vector constructed from a spatial signature of the plurality of spatial signatures associated with the at least one uplink signal, the construction taking into account noise and interference characteristics as well as other spatial parameters to maximize signal-to-interference-and noise performance.

51. The smart antenna base station according to claim 46 wherein said demodulator is further responsive to said spatial signature estimator for constructively combining at least one uplink signal of the plurality of uplink signals received upon each element of the array of antenna elements to produce a constructively combined demodulated uplink signal in response to an uplink beamforming vector constructed from a spatial signature of the plurality of spatial signatures associated with the at least one uplink signal, the construction taking into account noise and interference characteristics as well as other spatial parameters to maximize bit-error-rate performance.

52. The smart antenna base station according to claim 46 further comprising:

an antenna having the array of antenna elements for wirelessly receiving the plurality of uplink signals modulated upon the common carrier frequency;

a receiver having an array of receivers, each receiver correspondingly coupled to one element of the array of antenna elements, said receiver for separating the plurality of uplink signals from the common carrier frequency; wherein

said demodulator is coupled to said receiver and is for demodulating each of the plurality of uplink signals from each receiver of the array of receivers to produce the multiplicity of demodulated uplink signals, and further comprising

a transmitter having an array of transmitters, each transmitter correspondingly coupled to one element of the array of antenna elements, said transmitter for wirelessly transmitting the plurality of downlink signals on the common carrier frequency, wherein

said modulator is coupled to the array of antenna elements through said transmitter means.

53. The smart antenna base station according to claim 52 further comprising:

a combiner for digitally combining components of the multiplicity of modulated downlink signals associated with each element of the array of antenna elements to produce an array of combined signals, wherein the multiplicity of modulated downlink signals are of a digital nature;

a pulse shaper coupled to said combiner for digitally shaping each signal of the array of combined signals to produce a corresponding array of digitally shaped signals; and

a digital to analog converter coupled to said pulse shaper and said transmitter for converting the array of digitally shaped signals to a corresponding array of analog shaped signals, wherein

said transmitter modulates the array of analog shaped signals upon the common carrier frequency.

54. The smart antenna base station according to claim 53 wherein, said modulator means, said downlink beamformer and said combiner are comprised within a fast hadamard transform means.

55. The smart antenna base station according to claim 52 further comprising:

a pulse shaper coupled to said modulator for digitally shaping the each component of the multiplicity of modulated downlink signals to produce a corresponding multiplicity of digital shaped signals;

a digital to analog converter coupled to said pulse shaper for converting the multiplicity of digitally shaped signals to a corresponding multiplicity of analog shaped signals; and

an analog combiner coupled to said digital to analog converter for combining the components of the multiplicity of analog shaped signals associated with each element of the array of antenna elements to produce an array of combined signals; wherein

said transmitter modulates the array of combined signals upon the common carrier frequency.

56. The smart antenna base station according to claim 41 wherein each of the plurality of uplink signals include a unique PN sequence from each of the plurality of remote terminals and further comprises:

a despreader for despreading each PN sequence to obtain a multichannel symbol sequence comprising a plurality of symbol sequences wherein said spatial signature estimator

identifies a first symbol sequence from the multichannel symbol sequence having a maximum power,

normalizes the multichannel symbol sequence with respect to the first symbol sequence to produce a normalized multichannel symbol sequence; and

calculates an average of the normalized multichannel symbol sequence to estimate a corresponding one of the plurality of spatial signatures.

57. The smart antenna base station according to claim 41 wherein each of the plurality of uplink signals include a unique PN sequence from each of the plurality of remote terminals and further comprises:

a despreader for despreading each PN sequence to obtain a multichannel symbol sequence comprising a plurality of symbol sequences wherein said spatial signature estimator

forms a data covariance matrix of the multichannel symbol sequence, and

calculates a principal eigen vector of the data covariance matrix to estimate a corresponding one of the plurality of spatial signatures.

58. A smart antenna base station comprising:

a spatial signature estimator for estimating a plurality of spatial signatures associated with a plurality of uplink signals received from a corresponding plurality of remote terminals wirelessly coupled to the base station, the plurality of uplink signals simultaneously received on a common carrier frequency during an uplink time slot;

a downlink beamformer coupled to said spatial signature estimator and responsive to the plurality of spatial signatures for beamforming a plurality of downlink beamforms correspondingly unique to each of the plurality of remote terminals and for simultaneously transmitting a plurality of downlink signals to the plurality of remote terminals on the common carrier frequency during a downlink time slot subsequent to the uplink time slot; and

a code division multiple access modulator coupled to said downlink beamformer for code modulating each of the plurality of downlink signals on a corresponding plurality code channels whereby each of the plurality of downlink signals has a unique downlink beamform and a unique code channel on the common carrier frequency.

59. The smart antenna base station according to claim 58 wherein said spatial signature estimator determines a timing offset unique to each of the plurality of remote terminals for communication thereto, thereby enabling synchronization of each of the plurality received uplink signals.

60. The smart antenna base station according to claim 58 further comprising a parameter estimator coupled to said spatial signature estimator for further processing at least one of the plurality of spatial signatures for determining a corresponding direction of arrival vector associated with a remote terminal of the plurality of remote terminals, wherein said downlink beamformer is not dependent upon the direction of arrival vector for beamforming a downlink beamform associated with the remote terminal.

61. The smart antenna base station according to claim 58 wherein at least one of the plurality of downlink beamforms is substantially identical to a corresponding at least one of the plurality of spatial signatures.

62. The smart antenna base station according to claim 58 wherein at least one of the plurality of downlink beamforms is optimized for maximum signal-to-interference- and noise performance by accounting for noise characteristics as well as other spatial parameters.

63. The smart antenna base station according to claim 58 wherein at least one of the plurality of downlink beamforms is optimized for maximum bit-error-rate performance by accounting for noise characteristics as well as other spatial parameters.

64. The smart antenna base station according to claim 58 further comprising:

a demodulator for demodulating each of the plurality of uplink signals received by an array of antenna elements to produce a multiplicity of demodulated uplink signals having the plurality of uplink signals received by each element of the array of antenna elements, wherein

said spatial signature estimator is coupled to said demodulator and estimates the plurality of spatial signatures in response to the multiplicity of demodulated uplink signals, the smart antenna base station further comprising

a modulator coupled to the array of antenna elements and said downlink beamformer for producing a multiplicity of modulated downlink signals having components associated with each element of the array of antenna elements by uniquely modulating each of the plurality of downlink signals for each element of the array of antenna elements to beamform the plurality of downlink beamforms.

65. The smart antenna base station according to claim 64 wherein each of the spatial signatures is either a vector or a matrix, further wherein the matrix is used in applications where a propagation channel is frequency selective with long delay multipath.

66. The smart antenna base station according to claim 64 wherein the number of the plurality of downlink beamforms exceeds the number of elements of the array of antenna elements thereby making the base station an adaptive antenna system rather than a sectored antenna system.

67. The smart antenna base station according to claim 64 wherein said demodulator is further responsive to said spatial signature estimator for constructively combining at least one uplink signal of the plurality of uplink signals received upon each element of the array of antenna elements to produce a constructively combined demodulated uplink signal in response to an uplink beamforming vector substantially identical to a spatial signature of the plurality of spatial signatures associated with the at least one uplink signal.

68. The smart antenna base station according to claim 64 wherein said demodulator is further responsive to said spatial signature estimator for constructively combining at least one uplink signal of the plurality of uplink signals received upon each element of the array of antenna elements to produce a constructively combined demodulated uplink signal in response to an uplink beamforming vector constructed from a spatial signature of the plurality of spatial signatures associated with the at least one uplink signal, the construction taking into account noise and interference characteristics as well as other spatial parameters to maximize signal-to-interference-and noise performance.

69. The smart antenna base station according to claim 64 wherein said demodulator is further responsive to said spatial signature estimator for constructively combining at least one uplink signal of the plurality of uplink signals received upon each element of the array of antenna elements to produce a constructively combined demodulated uplink signal in response to an uplink beamforming vector constructed from a spatial signature of the plurality of spatial signatures associated with the at least one

uplink signal, the construction taking into account noise and interference characteristics as well as other spatial parameters to maximize bit-error-rate performance.

70. The smart antenna base station according to claim 64 further comprising:

an antenna having the array of antenna elements for wirelessly receiving the plurality of uplink signals modulated upon the common carrier frequency;

a receiver having an array of receivers, each receiver correspondingly coupled to one element of the array of antenna elements, said receiver for separating the plurality of uplink signals from the common carrier frequency; wherein

said demodulator is coupled to said receiver and is for demodulating each of the plurality of uplink signals from each receiver of the array of receivers to produce the multiplicity of demodulated uplink signals, and further comprising

a transmitter having an array of transmitters, each transmitter correspondingly coupled to one element of the array of antenna elements, said transmitter for wirelessly transmitting the plurality of downlink signals on the common carrier frequency, wherein

said modulator is coupled to the array of antenna elements through said transmitter means.

71. The smart antenna base station according to claim 70 further comprising:

a combiner for digitally combining components of the multiplicity of modulated downlink signals associated with each element of the array of antenna elements to produce an array of combined signals, wherein the multiplicity of modulated downlink signals are of a digital nature;

a pulse shaper coupled to said combiner for digitally shaping each signal of the array of combined signals to produce a corresponding array of digitally shaped signals; and

a digital to analog converter coupled to said pulse shaper and said transmitter for converting the array of digitally shaped signals to a corresponding array of analog shaped signals, wherein

said transmitter modulates the array of analog shaped signals upon the common carrier frequency.

72. The smart antenna base station according to claim 71 wherein, said modulator means, said downlink beamformer and said combiner are comprised within a Fast Hadamard Transform means.

73. The smart antenna base station according to claim 70 further comprising:

a pulse shaper coupled to said modulator for digitally shaping the each component of the multiplicity of modulated downlink signals to produce a corresponding multiplicity of digital shaped signals;

a digital to analog converter coupled to said pulse shaper for converting the multiplicity of digitally shaped signals to a corresponding multiplicity of analog shaped signals; and

an analog combiner coupled to said digital to analog converter for combining the components of the multiplicity of analog shaped signals associated with each element of the array of antenna elements to produce an array of combined signals; wherein

said transmitter modulates the array of combined signals upon the common carrier frequency.

74. The smart antenna base station according to claim 58 wherein each of the plurality of uplink signals include a unique PN sequence from each of the plurality of remote terminals and further comprises:

a despreader for despreading each PN sequence to obtain a multichannel symbol sequence comprising a plurality of symbol sequences wherein said spatial signature estimator

identifies a first symbol sequence from the multichannel symbol sequence having a maximum power,

normalizes the multichannel symbol sequence with respect to the first symbol sequence to produce a normalized multichannel symbol sequence; and

calculates an average of the normalized multichannel symbol sequence to estimate a corresponding one of the plurality of spatial signatures.

75. The smart antenna base station according to claim 58 wherein each of the plurality of uplink signals include a unique PN sequence from each of the plurality of remote terminals and further comprises:

a despreader for despreading each PN sequence to obtain a multichannel symbol sequence comprising a plurality of symbol sequences wherein said spatial signature estimator

forms a data covariance matrix of the multichannel symbol sequence, and

calculates a principal eigen vector of the data covariance matrix to estimate a corresponding one of the plurality of spatial signatures.